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FREE AMINO ACIDS IN THE SOIL

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A number of amino acids have been identified during recent years in mineral soils and especially in Peat-Bog soils [2, 6-8, 11-13, etc.]. They form as a result of the hydrolysis of proteins in plant and animal residues that are added to the soil. The root secretions of higher plants are an important source of replenishment of free soil amino acids, as is the saprophytic population of the soil. The relatively high proteolytic activity of a number of soils is evidence for a constant process of hydrolysis of soil proteins, which normally are a significant component of the organic matter of the soil [6, etc.]. /523*

Soil amino acids in the free state evidently are an important component of the root nutrition of plants. As early as the beginning of this century the eminent physiologist Shulov [4] demonstrated that higher plants utilize amino acids. In subsequent years a number of interesting works have been devoted to problems of the utilization of amino acids by higher and lower plants [3, 5, 9, 10, 14, 15, etc.].

Attention has not been given in the USSR to the study of free amino acids in the soil. Hence the research results reported in the present paper may serve as a stimulus for further work in this direction.

Various authors have extracted amino acids from the soil with water [6, 8, 11], 70-80 degree alcohol [12, 13], 0.1 N barium hydroxide, 0.5 N ammonium acetate, etc.

A number of solvents for extracting soil amino acids have also been studied in our laboratory, particularly water, "hydrochloric" acetone, and 80-degree alcohol. Cold 80-degree alcohol gave the best extraction results (two parts soil to one part alcohol, by weight). Extraction times ranged from 4 hours to 4 days. The alcohol extract was evaporated to dryness in an exhaust hood. The residue was dissolved in 1 cm^3 of 10% isopropyl alcohol. 160-220 μl of solution was used for the chromatogram. Boyarkin's method of chromatography was used [1].

As our earlier studies showed [2], the water saturating Peat-Bog soils contain a considerable quantity of amino acids. Hence primary attention was

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*Numbers in the margin indicate pagination in the foreign text.

given to the study of amino acids in Peat-Bog soils. Samples were collected from vast areas of cultivated low-moor Peat-Bog soils in Brest oblast and from uncultivated soils of Minsk Bog Station. A sample of mineral soil was collected from a grassy tract of the Botanic Garden of the BSSR Academy of Sciences.

The largest quantity of free amino acids was found in the mineral grass-covered soil (cf. Table 1 and Fig. 1). As is seen in one of the chromatograms (Fig. 1, Sample 4) made from extracts of this soil, glutamic acid was found to be most abundant, followed by glycine and threonine. Judging from the chromatograms, the other six are present in insignificant quantities (aspartic acid, alanine, valine, methionine, phenylalanine, and leucine). The greatest number of amino acids (serine, aspartic and glutamic acids, glycine, alanine, valine, and leucine) was found in the sample of Peat-Bog soil from the Grivda River valley. Only aspartic and glutamic acids and alanine were identified in the sample from the Minsk Bog Station (uncultivated soil). /524

Table 1

Description of sample	Date of determination	Amino acids										
		Cystine	Aspartic acid	Glutamic acid	Serine	Glycine	Threonine	Alanine	Valine	Methionine	Phenylalanine	Leucine
No. 1. Ivatsevichi Rayon, Brest Oblast. Grivda River valley. Peat-Bog cultivated soil of the low-moor type on reed-sedge peat. Degree of decomposition of the peat, 40%. Planted in hemp. Sample depth 0-10 cm. June 1960.	January 1962		+	+	+	+		+	+			+
No. 2. Ivatsevichi Rayon, Brest Oblast. Kossovskaya Peat-Bog Experiment Station. Peat-Bog cultivated soil of the low-moor type. Three-year-old grasses. Depth 0-5 cm. August 25, 1961.	December 27, 1961	+	+	+				+				

Table 1 (Continued)

Description of sample	Date of determination	Amino acids										
		Cystine	Aspartic acid	Glutamic acid	Serine	Glycine	Threonine	Alanine	Valine	Methionine	Phenylalanine	Leucine
No. 3. Minsk Peat-Bog Experiment Station. Peat-Bog uncultivated soil of the low-moor type. Depth 0-10 cm. August 14, 1961.	January 13, 1962		+	+				+				
No. 4. Botanical Garden, Academy of Sciences of the Byelorussian SSR. Podzolic loamy sand, gleyish, temporary excessive wetness. Grassed. Depth 0-10 cm. August 1960.	September 1961		+	+		+	+	+	+	+	+	+

Our determination indicates, and the previously mentioned work of other authors agrees, that glutamic acid is always present in soils in relatively large amounts. Generally speaking this amino acid is very important in metabolism and is widely distributed. Certain plants accumulate a very large amount of glutamic acid and glutamine in addition to aspartic acid. Evidently these plants are also the principal suppliers of glutamic acid to the soil.

The role of free soil amino acids in the "soil" nutrition of plants is still unknown. It can be said that glutamic acid is of considerable importance as a factor in the growth of many microorganisms living in the soil. Evidently amino acids are not in last place as a source of nitrogen among the soil organic compounds utilized by higher plants. /525

The laboratory plans further studies of soil amino acids.

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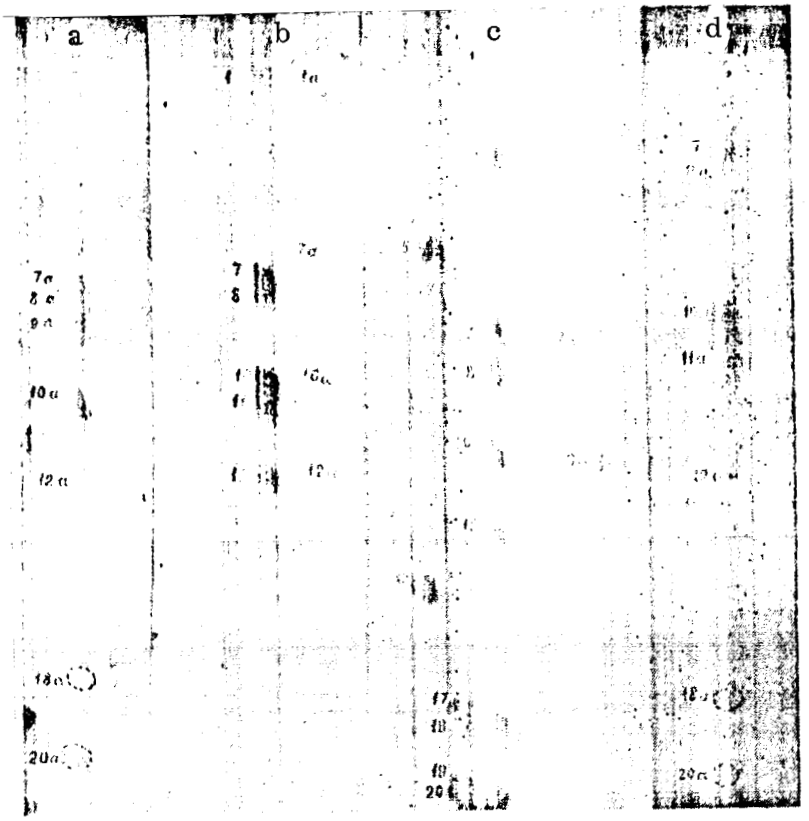

Figure 1. Chromatograms of Soil Amino Acids. (Numbers With the Letter "a" Are Amino Acids Found in the Soil; the Others Are Markers. a—Sample No. 1, b—No. 2, c—No. 3, and d—No. 4.)

1—Cystine; 2—Lysine; 5—Arginine; 7—Aspartic Acid; 8—Serine; 9—Glycine; 10—Glutamic Acid; 11—Threonine; 12—Alanine; 15—Tyrosine; 17—Methionine; 18—Valine; 19—Phenylalanine; 20—Leucine.

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